BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H01J 65/04

A1

(11) International Publication Number: WO 00/33351

(43) International Publication Date: 8 June 2000 (08.06.00)

(21) International Application Number: PCT/EP99/08936

(22) International Filing Date: 17 November 1999 (17.11.99)

(30) Priority Data:
98204044.6 30 November 1998 (30.11.98) EP

(71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(71) Applicant *(for DE only)*: PHILIPS CORPORATE INTELLECTUAL PROPERTY GMBH [DE/DE]; Habsburgerallee 11, D-52066 Aachen (DE).

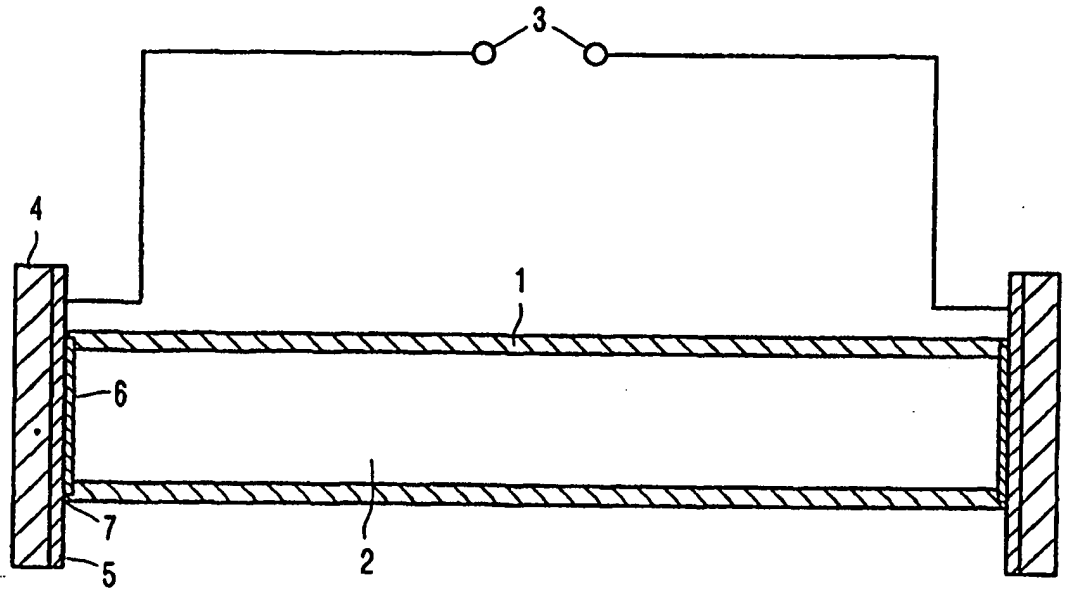
(72) Inventors: BACHMANN, Peter, K.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). RAUSENBERGER, Bernd; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). WILSON, Howard; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). KRAUS, Albrecht; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). BRAUN, Norbert; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(74) Agent: BOSMA, Rudolphus, H., A.; Internationaal Octrooibureau B.V., Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(81) Designated States: CN, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: DISCHARGE LAMP



(57) Abstract

In a capacitively coupled discharge lamp the electrode (4, 5, 6) comprises a dielectric material (6) that during operation is in contact with the discharge. The impedance of the dielectric material is small and its electron affinity is negative. In this way it is realized that the discharge lamp can be operated efficiently at low frequencies (less than 500 KHz).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Discharge lamp.

The invention relates to a discharge lamp equipped with a gastight discharge vessel containing a gas and equipped with electrodes, at least one of said electrodes comprising

- a first part that is suitable for connection to a pole of a supply voltage source and that during operation is capacitively coupled to the discharge in the discharge lamp,
- a second part formed out of a first dielectric material, said second part being connected to the first part and during operation of the discharge lamp being in contact with the discharge.

Such a discharge lamp is known from US 2,624,858. In the known discharge lamp the first part of both electrodes is formed out of metal or deposited graphite. The second part of the electrodes is relatively thick and the dielectric constant M of first dielectric material is higher than 100. During operation of the lamp the operating voltage that is applied to the first part of the first electrode and the first part of a second electrode is coupled capacitively to the discharge by means of the second part of the first electrode and the second part of the second electrode. Both electrodes form capacitive impedances during the operation of the lamp. These capacitive impedances render the current/voltage characteristic of the discharge lamp positive so a separate external ballast element can be dispensed with. Since the dielectric constant M of first dielectric material is higher than 100, the capacitive impedances of both electrodes are relatively low, so that the lamp can be operated at relatively low frequencies (e.g. less than 500 KHz). An important disadvantage of the known discharge lamp, however, is that virtually each material that has a high dielectric constant also has a relatively high electron affinity. Because of this high electron affinity electrons adhere relatively strongly to the surface of the second parts of the electrodes. This results in a relatively high lamp voltage, a corresponding low efficiency of the lamp and also to blackening of the wall of the discharge vessel in the vicinity of the electrodes.

The invention aims to provide a discharge lamp that during operation is capacitively coupled to a supply voltage source and can be operated by means of a low frequency (less than 500 KHz) supply voltage, with a relatively high efficiency and a relatively low amount of blackening of the discharge vessel.

A discharge lamp as mentioned in the opening paragraph is therefore in accordance with the invention characterized in that the electron affinity _ of the first dielectric material is negative.

It has been found that the negative electron affinity of the first dielectric material causes the efficiency of a discharge lamp according to the invention to be relatively high. In practice the dielectric constant of the first dielectric material is very often relatively low, e.g. lower than 10. In order to keep the capacitive impedances of the electrodes acceptably low, it is often necessary to choose the thickness of the dielectric material in the direction of the lamp current relatively small, i.e. smaller than 100 Tm, whereas the best results have been obtained thicknesses smaller than 1 Tm.

Very good results have been obtained for discharge lamps according to the invention in which the first dielectric material is chosen from the group formed by diamond, AlN, AlGaN and BN.

Since in practice the second part of the electrode is relatively thin it is often desirable to realize electrical insulation of the first electrode part from the discharge making use of a third part consisting of a second dielectric material having a dielectric constant M higher than 100 and preferably higher than 1000, the third part of the electrode being situated between and in contact with both the first part and the second part of the electrode.

Preferably the first part of an electrode in a discharge lamp according to the invention comprises a flat metallic layer while the second part comprises a sheet of the first dielectric material parallel to the flat metallic layer. In case the electrode comprises a third part, this third part can conveniently be realized in case it comprises a sheet of the second dielectric material parallel to the first and the second part of the electrode.

It has been found in practice that it is desirable for the electrode to comprise a carrier for rendering mechanical strength to the electrode construction, said carrier being in parallel with the second electrode part. The carrier can be a separate part of the electrode but it is also possible that the carrier is formed by the first electrode part.

In case the electrode comprises a third part, the carrier can also be formed by this third part.

An embodiment of the invention will be described making use of a drawing. In the drawing Fig. 1 shows a schematic representation of a discharge lamp according to the invention, and

Fig. 2 shows a schematic representation of three alternative electrode configurations that can be used in discharge lamp according to the invention.

In Fig. 1, 1 is a discharge tube comprising a gas. 5, 7 and 4 together form an electrode and are first, second and third parts of this electrode respectively. 3 are contacts for connection to the poles of a supply voltage source. Contacts 3 are connected to the first parts of respective electrodes. 2 indicates the space enclosed by the electrodes and the discharge vessel, where the discharge is present during operation of the discharge lamp. 7 indicates a gastight seal between the electrodes and the discharge tube. In this embodiment the electrodes, the discharge tube and the seals between discharge tube and electrodes together form a gastight discharge vessel.

The electrodes were manufactured as follows. A sheet of glass (Corning 7059) was covered with a layer of titanium with a thickness of approximately 100 nm by means of evaporation. The glass sheet including the titanium layer was treated at a temperature of 600 C in a reducing atmosphere during 30 minutes. During this treatment diffusion of titanium into the glass takes place resulting in an electrically conductive and mechanically stable titanium layer. Next the titanium layer was ground with diamond powder to implant diamond particles in the surface of the titanium layer. The sheet was then covered with a diamond layer by means of a microwave CVD process carried out at a temperature of 650 C and a pressure of 15 torr. The power of the microwaves was 800 Watt and use was made of a gas mixture containing carbon, hydrogen and oxygen. The thickness of the diamond sheet was approximately 300 nm and it was H-terminated, meaning that its surface was covered with hydrogen. By making use of a mask it was realized that the diameter of the diamond layer was slightly bigger than the inner diameter of the discharge tube. The titanium layer and the diamond layer were connected to the discharge tube 1 in gastight way making use of a glass containing lead at a temperature of approximately 650 C. The lamp vessel was evacuated and filled with 5 mg mercury and 3 mBar argon. In the electrodes used in this discharge lamp the

titanium layer forms a first part, the diamond layer forms a second part and the glass forms a carrier of the electrode. By means of UV photo electron spectroscopy an electron affinity _ of approximately - 1 eV was found for the hydrogen covered diamond layer.

In all three electrode configurations 1, 2 and 3 in Fig. 2, A is a first electrode part being a layer of an electrically conductive material such as a metal. C is a second part of the electrode that is formed out of a first dielectric material. The part C is connected to the part A and the part C is in contact with the discharge during operation of the lamp. In all embodiments W is the wall of the gastight discharge vessel. In embodiments 1 and 3 the second electrode part C is directly connected to the first electrode part A. In embodiment 2 B forms a third electrode part formed out of a second dielectric material having a dielectric constant M higher than 100 and preferably higher than 1000, the third part of the electrode being in situated between and in contact with both the first part A and the second part C of the electrode. In embodiment 3, B is a carrier formed out of a dielectric material that is in contact with the the first part A of the electrode. The electrode construction in embodiment 3 of Fig. 2 is very similar to that shown in Fig 1. During lamp operation the poles of a supply voltage source are electrically connected to the first part A of the electrode.

CLAIMS:

1. Discharge lamp equipped with a gastight discharge vessel containing a gas and equipped with electrodes, at least one of said electrodes comprising

- a first part that is suitable for connection to a pole of a supply voltage source and that during operation is capacitively coupled to the discharge in the discharge lamp,
- a second part formed out of a first dielectric material, said second part being connected to the first part and during operation of the discharge lamp being in contact with the discharge,

characterized in that the electron affinity _ of the first dielectric material is negative.

2. Discharge lamp according to claim 1, wherein the first part comprises a layer of an electrically conductive material, preferably a metal, and the second part comprises a sheet of the first dielectric material parallel to the flat metallic layer.

3. Discharge lamp according to claim 1 or 2, wherein the thickness of the second part in the direction of the lamp current is less than 100 Tm, preferably less than 1 Tm.

4. Discharge lamp according to claim 1, wherein the electrode comprises a third part consisting of a second dielectric material having a dielectric constant M higher than 100 and preferably higher than 1000, the third part of the electrode being in situated between and in contact with both the first part and the second part of the electrode.

5. Discharge lamp according to claim 2 and 4, wherein the third part comprises a sheet of the second dielectric material parallel to the first and the second part of the electrode.

6. Discharge lamp according to one or more of the previous claims, wherein the first dielectric material is chosen from the group formed by diamond, AlN, AlGaN and BN.

7. Discharge lamp according to one or more of the previous claims, in which the electrode comprises a carrier for rendering mechanical strength to the electrode construction, said carrier being in parallel with the second electrode part.

8. Discharge lamp according to claim 7, wherein the carrier is formed by the first electrode part.

9. Discharge lamp according to claim 4 and 7, wherein the carrier is formed by the third electrode part.

1/1

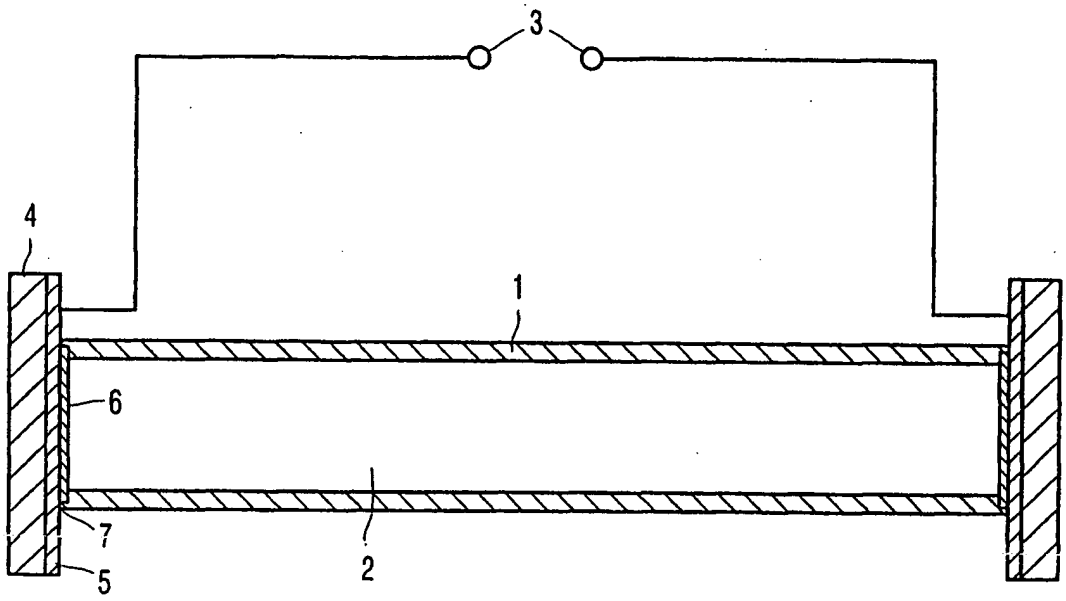


FIG. 1

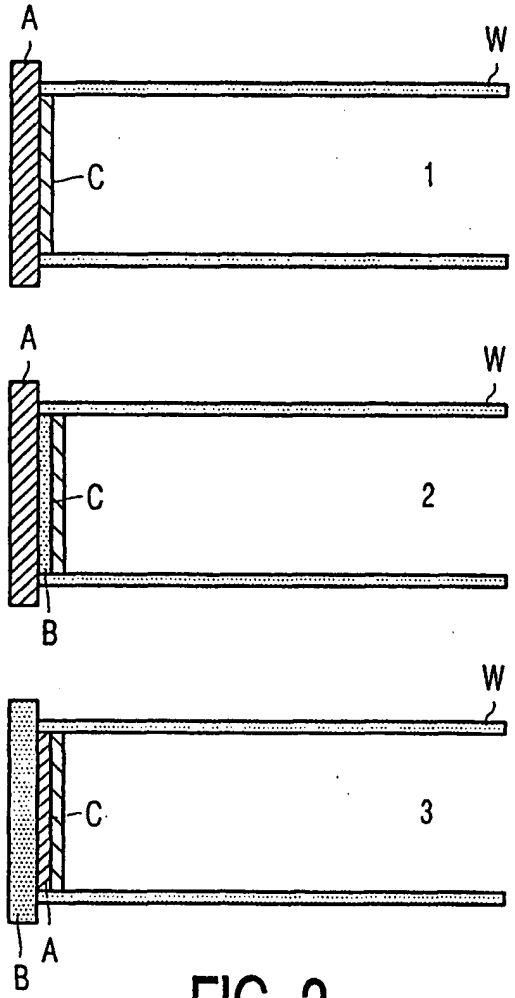


FIG. 2

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/EP 99/08936

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01J65/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2 624 858 A (GREEN LEE) 6 January 1953 (1953-01-06) cited in the application column 3, line 58 -column 4, line 22; figure 1	1,6
A		2-5,7-9
Y	GB 2 297 862 A (SMITHS INDUSTRIES PLC) 14 August 1996 (1996-08-14) claims 1,3,7,8; figure 2	1,6
A	US 5 199 918 A (KUMAR NALIN) 6 April 1993 (1993-04-06) abstract; figure 2	1,6
A	US 5 138 237 A (KANE ROBERT C ET AL) 11 August 1992 (1992-08-11) claims 1,2,4; figure 1A	1,6,7

-/—

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 February 2000	06/03/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Deroubaix, P

INTERNATIONAL SEARCH REPORT

Int. Jonal Application No
PCT/EP 99/08936

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 180 951 A (KANE ROBERT C ET AL) 19 January 1993 (1993-01-19) claim 3; figure 7	1,6
A	EP 0 764 965 A (AT & T CORP) 26 March 1997 (1997-03-26) claims 1-4	1,3,6
A	WO 94 28571 A (MICROELECTRONICS & COMPUTER) 8 December 1994 (1994-12-08) claims 1,4,6; figure 4	1,4,6

INTERNATIONAL SEARCH REPORT

information on patent family members

Inte onal Application No
PCT/EP 99/08936

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2624858 A	06-01-1953	NONE	
GB 2297862 A	14-08-1996	DE 19601138 A	14-08-1996
		FR 2730333 A	09-08-1996
		US 5663611 A	02-09-1997
US 5199918 A	06-04-1993	US 5536193 A	16-07-1996
		US 5861707 A	19-01-1999
		US 5341063 A	23-08-1994
US 5138237 A	11-08-1992	CA 2070942 A	21-02-1993
		EP 0528390 A	24-02-1993
		JP 5205612 A	13-08-1993
US 5180951 A	19-01-1993	DE 69300157 D	29-06-1995
		DE 69300157 T	04-01-1996
		EP 0555076 A	11-08-1993
		HK 1000225 A	06-02-1998
		JP 6020591 A	28-01-1994
EP 0764965 A	26-03-1997	US 5982095 A	09-11-1999
		JP 9120778 A	06-05-1997
WO 9428571 A	08-12-1994	AU 5897594 A	20-12-1994
		CA 2164294 A	08-12-1994
		EP 0730780 A	11-09-1996
		JP 8510858 T	12-11-1996
		US 5600200 A	04-02-1997
		US 5686791 A	11-11-1997
		US 5675216 A	07-10-1997
		US 5659224 A	19-08-1997
		US 5703435 A	30-12-1997

1/1

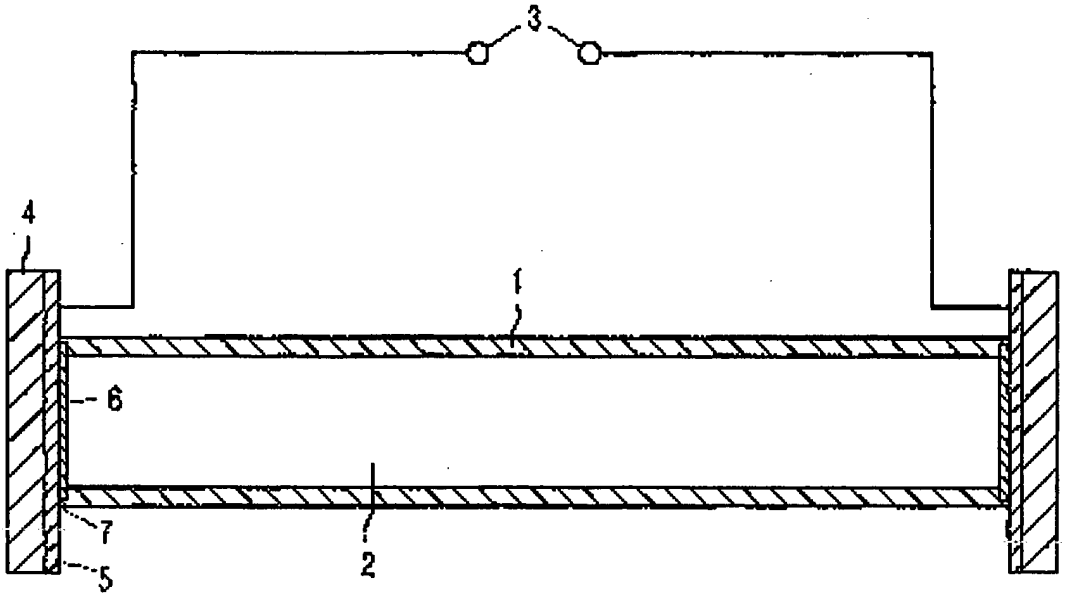


FIG. 1

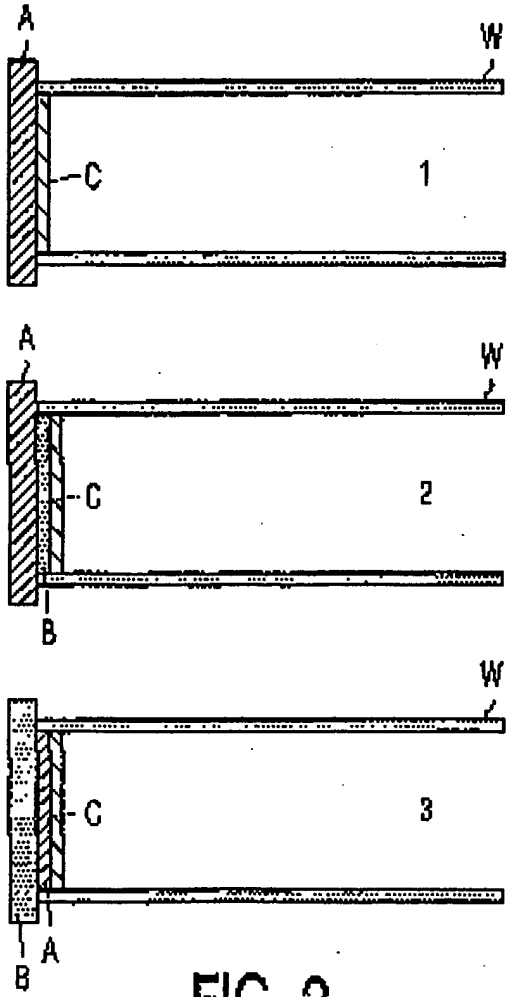


FIG. 2